

| Contents | Page |
|---|------|
| Foreword..... | ix |
| Introduction..... | x |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions..... | 2 |
| 4 Symbols and abbreviated terms..... | 5 |
| 5 Conventions | 5 |
| 6 Document overview..... | 6 |
| 7 Application layer services | 7 |
| 7.1 General | 7 |
| 7.2 Format description of application layer services | 9 |
| 7.3 Format description of service primitives | 9 |
| 7.3.1 General definition..... | 9 |
| 7.3.2 Service request and service indication primitives | 10 |
| 7.3.3 Service response and service confirm primitives..... | 11 |
| 7.3.4 Service request-confirm and service response-confirm primitives | 11 |
| 7.4 Service data unit specification..... | 12 |
| 7.4.1 Mandatory parameters..... | 12 |
| 7.4.2 Vehicle system requirements..... | 14 |
| 7.4.3 Optional parameters - A_AE, application layer remote address..... | 15 |
| 8 Application layer protocol..... | 15 |
| 8.1 General definition..... | 15 |
| 8.2 A_PDU, application protocol data unit | 16 |
| 8.3 A_PCI, application protocol control information | 16 |
| 8.4 SI, service identifier | 17 |
| 8.5 A_NR_SI, Negative response service identifier | 17 |
| 8.6 Negative response/confirmation service primitive..... | 18 |
| 8.7 Server response implementation rules..... | 18 |
| 8.7.1 General definitions..... | 18 |
| 8.7.2 General server response behaviour | 19 |
| 8.7.3 Request message with SubFunction parameter and server response behaviour | 21 |
| 8.7.4 Request message without SubFunction parameter and server response behaviour | 25 |
| 8.7.5 Pseudo code example of server response behaviour | 27 |
| 8.7.6 Multiple concurrent request messages with physical and functional addressing..... | 29 |
| 9 Service description conventions | 29 |
| 9.1 Service description | 29 |
| 9.2 Request message..... | 30 |
| 9.2.1 Request message definition | 30 |
| 9.2.2 Request message SubFunction parameter \$Level (LEV_) definition | 31 |
| 9.2.3 Request message data-parameter definition | 33 |
| 9.3 Positive response message..... | 33 |
| 9.3.1 Positive response message definition..... | 33 |
| 9.3.2 Positive response message data-parameter definition | 34 |

| | | |
|---------------|---|------------|
| 9.4 | Supported negative response codes (NRC_) | 34 |
| 9.5 | Message flow examples | 35 |
| 10 | Diagnostic and communication management functional unit | 36 |
| 10.1 | Overview | 36 |
| 10.2 | DiagnosticSessionControl (10₁₆) service | 36 |
| 10.2.1 | Service description | 36 |
| 10.2.2 | Request message | 40 |
| 10.2.3 | Positive response message | 41 |
| 10.2.4 | Supported negative response codes (NRC_) | 42 |
| 10.2.5 | Message flow example(s) DiagnosticSessionControl – Start programmingSession | 43 |
| 10.3 | ECUReset (11₁₆) service | 43 |
| 10.3.1 | Service description | 43 |
| 10.3.2 | Request message | 44 |
| 10.3.3 | Positive response message | 45 |
| 10.3.4 | Supported negative response codes (NRC_) | 46 |
| 10.3.5 | Message flow example ECUReset | 47 |
| 10.4 | SecurityAccess (27₁₆) service | 47 |
| 10.4.1 | Service description | 47 |
| 10.4.2 | Request message | 49 |
| 10.4.3 | Positive response message | 51 |
| 10.4.4 | Supported negative response codes (NRC_) | 51 |
| 10.4.5 | Message flow example(s) SecurityAccess | 52 |
| 10.5 | CommunicationControl (28₁₆) service | 54 |
| 10.5.1 | Service description | 54 |
| 10.5.2 | Request message | 54 |
| 10.5.3 | Positive response message | 56 |
| 10.5.4 | Supported negative response codes (NRC_) | 56 |
| 10.5.5 | Message flow example CommunicationControl (disable transmission of network management messages) | 57 |
| 10.5.6 | Message flow example CommunicationControl (switch a remote network into the diagnostic-only scheduling mode where the node with address 000A₁₆ is connected to) | 57 |
| 10.5.7 | Message flow example CommunicationControl (switch to application scheduling mode with enhanced address information, the node 000A₁₆, which is connected to a sub-network, is addressed) | 58 |
| 10.6 | Authentication (29₁₆) service | 59 |
| 10.6.1 | Service overview | 59 |
| 10.6.2 | Authentication with PKI Certificate Exchange (APCE) | 60 |
| 10.6.3 | Authentication with Challenge-Response (ACR) | 65 |
| 10.6.4 | Common requirements | 69 |
| 10.6.5 | Request message | 71 |
| 10.6.6 | Positive response message | 78 |
| 10.6.7 | Supported negative response codes (NRC_) | 85 |
| 10.6.8 | Message flow example(s) Authentication | 86 |
| 10.7 | TesterPresent (3E₁₆) service | 108 |
| 10.7.1 | Service description | 108 |
| 10.7.2 | Request message | 108 |
| 10.7.3 | Positive response message | 108 |
| 10.7.4 | Supported negative response codes (NRC_) | 109 |
| 10.7.5 | Message flow example(s) TesterPresent | 109 |
| 10.8 | ControlDTCSetting (85₁₆) service | 110 |
| 10.8.1 | Service description | 110 |
| 10.8.2 | Request message | 111 |

| | |
|---|------------|
| 10.8.3 Positive response message..... | 112 |
| 10.8.4 Supported negative response codes (NRC_) | 112 |
| 10.8.5 Message flow example(s) ControlDTCSetting | 113 |
| 10.9 ResponseOnEvent (86₁₆) service | 114 |
| 10.9.1 Service description | 114 |
| 10.9.2 Request message..... | 121 |
| 10.9.3 Positive response message..... | 127 |
| 10.9.4 Supported negative response codes (NRC_) | 130 |
| 10.9.5 Message flow example(s) ResponseOnEvent..... | 131 |
| 10.10 LinkControl (87₁₆) service..... | 146 |
| 10.10.1 Service description | 146 |
| 10.10.2 Request message | 147 |
| 10.10.3 Positive response message | 149 |
| 10.10.4 Supported negative response codes (NRC_) | 149 |
| 10.10.5 Message flow example(s) LinkControl | 150 |
| 11 Data transmission functional unit..... | 152 |
| 11.1 Overview..... | 152 |
| 11.2 ReadDataByIdentifier (22₁₆) service..... | 153 |
| 11.2.1 Service description | 153 |
| 11.2.2 Request message..... | 153 |
| 11.2.3 Positive response message..... | 154 |
| 11.2.4 Supported negative response codes (NRC_) | 155 |
| 11.2.5 Message flow example ReadDataByIdentifier..... | 157 |
| 11.3 ReadMemoryByAddress (23₁₆) service | 159 |
| 11.3.1 Service description | 159 |
| 11.3.2 Request message..... | 159 |
| 11.3.3 Positive response message..... | 161 |
| 11.3.4 Supported negative response codes (NRC_) | 161 |
| 11.3.5 Message flow example ReadMemoryByAddress..... | 163 |
| 11.4 ReadScalingDataByIdentifier (24₁₆) service..... | 166 |
| 11.4.1 Service description | 166 |
| 11.4.2 Request message..... | 166 |
| 11.4.3 Positive response message..... | 166 |
| 11.4.4 Supported negative response codes (NRC_) | 167 |
| 11.4.5 Message flow example ReadScalingDataByIdentifier | 169 |
| 11.5 ReadDataByPeriodicIdentifier (2A₁₆) service..... | 172 |
| 11.5.1 Service description | 172 |
| 11.5.2 Request message..... | 176 |
| 11.5.3 Positive response message..... | 176 |
| 11.5.4 Supported negative response codes (NRC_) | 177 |
| 11.5.5 Message flow example ReadDataByPeriodicIdentifier..... | 180 |
| 11.6 DynamicallyDefineDataIdentifier (2C₁₆) service | 191 |
| 11.6.1 Service description | 191 |
| 11.6.2 Request message..... | 192 |
| 11.6.3 Positive response message..... | 195 |
| 11.6.4 Supported negative response codes (NRC_) | 196 |
| 11.6.5 Message flow examples DynamicallyDefineDataIdentifier | 197 |
| 11.7 WriteDataByIdentifier (2E₁₆) service..... | 212 |
| 11.7.1 Service description | 212 |
| 11.7.2 Request message..... | 212 |
| 11.7.3 Positive response message..... | 213 |
| 11.7.4 Supported negative response codes (NRC_) | 214 |
| 11.7.5 Message flow example WriteDataByIdentifier | 215 |

| | |
|--|------------|
| 11.8 WriteMemoryByAddress (3D₁₆) service | 216 |
| 11.8.1 Service description | 216 |
| 11.8.2 Request message | 217 |
| 11.8.3 Positive response message | 218 |
| 11.8.4 Supported negative response codes (NRC_) | 219 |
| 11.8.5 Message flow example WriteMemoryByAddress | 221 |
| 12 Stored data transmission functional unit..... | 223 |
| 12.1 Overview | 223 |
| 12.2 ClearDiagnosticInformation (14₁₆) service | 223 |
| 12.2.1 Service description | 223 |
| 12.2.2 Request message | 224 |
| 12.2.3 Positive response message | 225 |
| 12.2.4 Supported negative response codes (NRC_) | 225 |
| 12.2.5 Message flow example ClearDiagnosticInformation..... | 226 |
| 12.3 ReadDTCInformation (19₁₆) service | 227 |
| 12.3.1 Service description | 227 |
| 12.3.2 Request message | 238 |
| 12.3.3 Positive response message | 249 |
| 12.3.4 Supported negative response codes (NRC_) | 263 |
| 12.3.5 Message flow examples – ReadDTCInformation..... | 264 |
| 13 InputOutput control functional unit | 297 |
| 13.1 Overview | 297 |
| 13.2 InputOutputControlByIdentifier (2F₁₆) service | 297 |
| 13.2.1 Service description | 297 |
| 13.2.2 Request message | 298 |
| 13.2.3 Positive response message | 299 |
| 13.2.4 Supported negative response codes (NRC_) | 300 |
| 13.2.5 Message flow example(s) InputOutputControlByIdentifier | 301 |
| 14 Routine functional unit | 310 |
| 14.1 Overview | 310 |
| 14.2 RoutineControl (31₁₆) service | 311 |
| 14.2.1 Service description | 311 |
| 14.2.2 Request message | 312 |
| 14.2.3 Positive response message | 314 |
| 14.2.4 Supported negative response codes (NRC_) | 315 |
| 14.2.5 Message flow example(s) RoutineControl | 317 |
| 15 Upload download functional unit..... | 321 |
| 15.1 Overview | 321 |
| 15.2 RequestDownload (34₁₆) service..... | 321 |
| 15.2.1 Service description | 321 |
| 15.2.2 Request message | 322 |
| 15.2.3 Positive response message | 323 |
| 15.2.4 Supported negative response codes (NRC_) | 324 |
| 15.2.5 Message flow example(s) RequestDownload..... | 325 |
| 15.3 RequestUpload (35₁₆) service..... | 325 |
| 15.3.1 Service description | 325 |
| 15.3.2 Request message | 326 |
| 15.3.3 Positive response message | 327 |
| 15.3.4 Supported negative response codes (NRC_) | 328 |
| 15.3.5 Message flow example(s) RequestUpload..... | 329 |
| 15.4 TransferData (36₁₆) service | 330 |
| 15.4.1 Service description | 330 |

| | |
|---|------------|
| 15.4.2 Request message..... | 330 |
| 15.4.3 Positive response message..... | 331 |
| 15.4.4 Supported negative response codes (NRC_) | 332 |
| 15.4.5 Message flow example(s) TransferData | 334 |
| 15.5 RequestTransferExit (37_{16}) service | 334 |
| 15.5.1 Service description | 334 |
| 15.5.2 Request message..... | 335 |
| 15.5.3 Positive response message..... | 335 |
| 15.5.4 Supported negative response codes (NRC_) | 336 |
| 15.5.5 Message flow example(s) for downloading/uploading data | 337 |
| 15.6 RequestFileTransfer (38_{16}) service | 344 |
| 15.6.1 Service description | 344 |
| 15.6.2 Request message..... | 344 |
| 15.6.3 Positive response message..... | 346 |
| 15.6.4 Supported negative response codes (NRC_) | 348 |
| 15.6.5 Message flow example(s) RequestFileTransfer..... | 350 |
| 16 Security sub-layer definition..... | 353 |
| 16.1 General | 353 |
| 16.1.1 Purpose | 353 |
| 16.1.2 Security sub-layer description. | 353 |
| 16.1.3 Security sub-layer access..... | 354 |
| 16.1.4 General server response behaviour | 356 |
| 16.2 SecuredDataTransmission (84_{16}) service..... | 358 |
| 16.2.1 Service description | 358 |
| 16.2.2 Request message..... | 358 |
| 16.2.3 Positive response message for successful internal message..... | 360 |
| 16.2.4 Supported negative response codes (NRC_) | 362 |
| 16.2.5 Message flow example SecuredDataTransmission | 363 |
| 17 Non-volatile server memory programming process | 366 |
| 17.1 General information | 366 |
| 17.2 Detailed programming sequence..... | 370 |
| 17.2.1 Programming phase #1 — Download of application software and/or application data | 370 |
| 17.3 Server reprogramming requirements | 379 |
| 17.3.1 Requirements for servers to support programming | 379 |
| 17.3.2 Software, data identification and fingerprints | 382 |
| 17.3.3 Server routine access | 383 |
| 17.4 Non-volatile server memory programming message flow examples | 383 |
| 17.4.1 General information | 383 |
| 17.4.2 Programming phase #1 — Pre-Programming step | 383 |
| 17.4.3 Programming phase #1 — Programming step..... | 384 |
| 17.4.4 Programming phase #1 — Post-Programming step | 389 |
| Annex A (normative) Global parameter definitions | 390 |
| Annex B (normative) Diagnostic and communication management functional unit data-parameter definitions | 400 |
| Annex C (normative) Data transmission functional unit data-parameter definitions | 405 |
| Annex D (normative) Stored data transmission functional unit data-parameter definitions.... | 422 |
| Annex E (normative) Input output control functional unit data-parameter definitions..... | 444 |
| Annex F (normative) Routine functional unit data-parameter definitions..... | 445 |
| Annex G (normative) Upload and download functional unit data-parameter..... | 447 |
| Annex H (informative) Examples for addressAndLengthFormatIdentifier parameter values... | 448 |
| Annex I (normative) Security access state chart..... | 450 |
| Annex J (informative) Recommended implementation for multiple client environments..... | 458 |
| Bibliography..... | 464 |